What is claimed is:

1. A scattering-reticle assembly for use in electron-beam microlithography of a pattern, defined by the reticle assembly, to a substrate, the reticle assembly comprising:

at least one scattering-stencil reticle portion defining a respective portion of the pattern; and

at least one scattering-membrane reticle portion defining a respective portion of the pattern.

2. The scattering-reticle assembly of claim 1, wherein each of the scattering-stencil reticle and scattering-membrane reticle portions is segmented into respective subfields.

3. The scattering-reticle assembly of claim 1, wherein each scattering-stencil reticle portion comprises a respective reticle membrane made of silicon.

4. The scattering-reticle assembly of claim 1, wherein each scattering-membrane reticle portion comprises a respective reticle membrane made of a material selected from the group consisting of Si, SiC, SiN, carbon, diamond, BN, and mixtures thereof.

5. The scattering-reticle assembly of claim 4, wherein each scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer being made of a material selected from the group consisting of Cr, W, Ta, and mixtures thereof.

6. The scattering-reticle assembly of claim 5, wherein each scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer having a transmittance to

electrons, of an incident electron beam, of no more than one-tenth of the respective reticle membrane.

7. The scattering-reticle assembly of claim 4, wherein each scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer having a transmittance to electrons, of an incident electron beam, of no more than one-tenth of the respective reticle membrane.

8. The reticle assembly of claim 1, further comprising a support frame, wherein the at least one scattering-stencil reticle portion and the at least one scattering-membrane reticle portion are bonded to respective locations on the support frame.

9. The reticle assembly of claim 1, comprising a first scattering-stencil reticle portion, a second scattering-stencil reticle portion, and a scattering-membrane reticle portion.

10. The reticle assembly of claim 9, wherein the second scattering-stencil reticle portion comprises subfields defining respective pattern features that are complementary to respective pattern features defined in subfields of the first scattering-stencil reticle portion.

11. An electron-beam (EB) microlithography apparatus, comprising:

an illumination system situated and configured to receive an illumination beam from an EB source and to direct the illumination beam to a selected region on a reticle assembly, and a projection system situated and configured to direct a portion of the beam passing through the reticle assembly to a substrate; and

a scattering-reticle assembly situated on a reticle stage so as to be illuminated by the illumination beam, the scattering-reticle assembly comprising at least one scattering-stencil reticle portion defining a respective portion of the pattern, and at

least one scattering-membrane reticle portion defining a respective portion of the pattern.

12. The apparatus of claim 11, wherein each of the scattering-stencil reticle and scattering-membrane reticle portions of the reticle assembly is segmented into respective subfields.

13. The apparatus of claim 11, wherein each scattering-stencil reticle portion of the reticle assembly comprises a respective reticle membrane made of silicon.

14. The apparatus of claim 11, wherein each scattering-membrane reticle portion of the reticle assembly comprises a respective reticle membrane made of a material selected from the group consisting of Si, SiC, SiN, carbon, diamond, BN, and mixtures thereof.

15. The apparatus of claim 14, wherein each scattering-membrane reticle portion of the reticle assembly further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer being made of a material selected from the group consisting of Cr, W, Ta, and mixtures thereof.

16. The apparatus of claim 15, wherein each scattering-membrane reticle portion of the reticle assembly further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer having a transmittance to electrons, of an incident electron beam, of no more than one-tenth of the respective reticle membrane.

17. The apparatus of claim 11, wherein the reticle assembly further comprises a support frame, wherein the at least one scattering-stencil reticle portion and the at least one scattering-membrane reticle portion are bonded to respective locations on the support frame.

18. The apparatus of claim 11, wherein the reticle assembly comprises a first scattering-stencil reticle portion, a second scattering-stencil reticle portion, and a scattering-membrane reticle portion.

19. The apparatus of claim 18, wherein the second scattering-stencil reticle portion of the reticle assembly comprises subfields defining respective pattern features that are complementary to respective pattern features defined in subfields of the first scattering-stencil reticle portion.

20. In an electron-beam (EB) microlithographic exposure method in which an electron beam is directed to a reticle assembly, defining a pattern, so as to acquire an ability to form an image of the pattern on a substrate, an improvement comprising:

on the reticle assembly defining a first pattern portion on at least one scattering-stencil reticle portion and defining a second pattern portion on at least one scattering-membrane reticle portion; and

using the electron beam, transferring the pattern portions from each reticle portion to the substrate so as to produce a stitched-together image of the pattern on the substrate.

21. The method of claim 20, wherein:

each of the reticle portions is divided into respective subfields each defining a respective portion of the pattern; and

the step of transferring the pattern portions comprises exposing the subfields individually to respective locations on the substrate so as to stitch together images of the respective portions of the pattern on the substrate.

22. The method of claim 20, wherein:

each scattering-stencil reticle portion comprises a respective reticle membrane defining pattern elements by respective through-holes in the reticle membrane; and

each scattering-membrane reticle portion comprises a respective reticle membrane including a pattern-defining layer made of a material different from a material used to form the respective reticle membrane.

23. An apparatus for performing a fabrication process on a wafer as required to produce a microelectronic device on the wafer, the apparatus comprising:

an electron-beam (EB) optical system; and

a scattering-reticle assembly situated relative to the EB optical system and defining a pattern that is projection-transferred to a substrate by an electron beam passing through the EB optical system, the scattering-reticle assembly comprising at least one scattering-stencil reticle portion defining a respective portion of the pattern, and at least one scattering-membrane reticle portion defining a respective portion of the pattern.

24. The apparatus of claim 23, wherein:

the scattering-reticle assembly further comprises a support frame; and

the at least one scattering-stencil reticle portion and the at least one scattering-membrane reticle portion are bonded to respective locations on the support frame.

25. The apparatus of claim 23, wherein each scattering-stencil reticle portion comprises a respective reticle membrane made of silicon.

26. The apparatus of claim 23, wherein each scattering-membrane reticle portion comprises a respective reticle membrane made of a material selected from the group consisting of Si, SiC, SiN, carbon, diamond, BN, and mixtures thereof.

27. The apparatus of claim 26, wherein each scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer being made of a material selected from the group consisting of Cr, W, Ta, and mixtures thereof.

28. The apparatus of claim 27, wherein each scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer having a transmittance to electrons, of an incident electron beam, of no more than one-tenth of the respective reticle membrane.

29. A method for fabricating a reticle assembly defining a pattern to be transferred microlithographically to a substrate using an electron beam, the method comprising:

fabricating a scattering-stencil reticle portion defining a first portion of the pattern;

fabricating a scattering-membrane reticle portion defining a second portion of the pattern; and

attaching the scattering-stencil reticle portion and the scattering-membrane reticle portion to a reticle frame.

30. The method of claim 29, wherein the scattering-stencil reticle portion is fabricated to include a respective reticle membrane made of silicon.

31. The method of claim 29, wherein the scattering-membrane reticle portion is fabricated to include a respective reticle membrane made of a material selected from the group consisting of Si, SiC, SiN, carbon, diamond, BN, and mixtures thereof.

32. The method of claim 31, wherein the scattering-membrane reticle portion further comprises a respective pattern-defining layer on the respective reticle

membrane, the pattern-defining layer being made of a material selected from the group consisting of Cr, W, Ta, and mixtures thereof.

33. The method of claim 32, wherein the scattering-membrane reticle portion is fabricated to further comprise a respective pattern-defining layer on the respective reticle membrane, the pattern-defining layer having a transmittance to electrons, of an incident electron beam, of no more than one-tenth of the respective reticle membrane.